2 p.m. Candidates for either the Classical or the Mathematical Studentships must not have exceeded the age of nineteen on January 1, 1881; candidates for the Natural Science Studentships must not have exceeded the age of twenty on the same day.

CAMBRIDGE.—There was a meeting of the members of the Senate on February 11, for the purpose of discussing the report of the Syndicate appointed last June to consider certain memorials as to the higher education of women. The Syndicate recommend that, subject to certain conditions of residence at Girton and Newnham Colleges, female students may be admitted to the Tripos Examinations, and certificates issued to them as to the result of the examination.—The Master of Emmanuel, in opening the discussion, remarked that he had never sat on any Syndicate before where so little difficulty had been experienced in agreeing to a report. Personally he wished the Syndicate had arrived at a different conclusion, and had recommended the admission of women to all the University examinations. He claimed for the recommendations of the Syndicate, however, that they closely followed the views of an influential number of residents who had signed a memorial on the subject, and wished for an official sanction to that which had been done for ten years without authority. He contended that it was the imperative duty of the University to give all possible access to its educational advantages, and that the proposed scheme was only a step in that direction.—Dr. Campion contended that the public opinion of the University had been carefully excluded in the constitution of the Syndicate. He charged the report with being both illiberal and harsh. It was illiberal, because the Syndicate had restricted the examinations to inmates of particular colleges, and was not for the encouragement of the higher education of women all over the country. Why was the advantage given only to Newnham and Girton Colleges? The report was harsh, for when they admitted women to test their scientific powers, it was unfair to do so after the conclusion of a time race with the men. Why not let the women study as long as they liked? He did not object to their being compelled to pass the previous examination, but to compel them to go step by step with undergraduates was placing them, by reason of their defect of physical power, in a false position.—Prof. Kennedy said, it was proposed to limit the competition to those within their reach; if the experiment succeeded, it would be a matter for future consideration what extensions should be made. As to the harshness, that surely might be left to the better judgment of the friends, relations, and guardians of these women who asked for these concessions. Women were mentally men's equals, but physically not. To urge their want of physical power as an objection to their admission to the same intellectual pursuits and pleasures as men was more for the Brahmin than the believer in the Bible; it was a fitter argument for the Turk than the Saxon.—Prof. Liveing defended the Syndicate from the attack of Dr. Campion, and asserted that the matter was discussed fully and fairly, without any bias of previously formed opinions.—Prof. Westcott, who did not concur in the whole of the report, expressed his great regret that the Syndicate before reporting had not collected further information on a problem so difficult and obscure.—Mr. Prothero, King's, was of opinion that the same course of training which was good for male students was equally good for women.—Mr. Sidgwick, Trinity, draw attention to the remarkable fact that no objection had been raised to the main proposal of the Syndicate.—The discussion lasted upwards of two hours.

KIEFF.—The number of students at the University of Kieff was, on January 1, 1881, as much as 1041, with fifty-eight professors.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science* for January contains notes on a peculiar form of Polyzoa closely allied to Bugula (Kinetoskias, Kor. and Dan.), by George Busk, F.R.S., with plates 1 and 2.—On the germination and histology of the seedling of *Welwitschia mirabilis*, by F. Orpen Bower, B.A., with plates 3 and 4.—Notes on some of the Reticularian Rhizopoda of the *Challenger*, by Henry B. Brady, F.R.S.—On the head-cavities and associated nerves of Elasmobranchs, by Prof. A. M. Marshall, M.A., with plates 5 and 6.—Contributions to the minute anatomy of the nasal mucous membrane, by Dr. E. Klein, F.R.S., with plate 7.—Histological notes, by Dr. E. Klein, F.R.S.—On the intra-cellular digestion and endoderm of Limnocodium, by E. R. Lankester, M.A., F.R.S., with plates 8 to 10.—On the micrometric numeration of the blood-corpuscles, and the estimation of their hæmoglobin, by Mrs. Ernest Hart.—Preliminary account of the development of the lampreys, by W. B. Scott, M.A.—On some appearances of the red blood-corpuscles of men and other vertebrata, by G. F. Dowdeswell, B.A.

THE *Journal of Anatomy and Physiology, Normal and Pathological*, vol. xv., part 2, January, 1881, contains—Dr. John Struthers, the bones, articulations, and muscles of the rudimentary hind-limb of the Greenland right-whale (*Balæna mysticetus*), (with four plates).—Dr. Creighton, on an infective form of tuberculosis in man identical with bovine tuberculosis.—Dr. W. Osler, medullary neuroma of the brain (plate 18).—A. Doran, case of fissure of the abdominal walls (plate 19).—Dr. D. Newman, description of a polygraph (with woodcut).—Dr. O. H. Jones, on the mechanism of the secretion of sweat.—Dr. P. S. Abraham, anomalous pilose growth in the pharynx of a woman (woodcut).—Dr. R. Saundby, histology of granular kidney (woodcut).—Dr. J. Oliver, two cases of cerebellar disease.—Prof. M'Kendrick, on the colouring-matter of jelly-fishes.—Dr. Cunningham, nerves of hind-limb of the Thylacine and Cuscus.—Dr. W. J. Fleming, pulse dicrotism.

THE *American Naturalist* for January, 1881, contains: Prof. A. Geikie, the ancient glaciers of the Rocky Mountains.—Fred. W. Simonds, the discovery of iron implements in an ancient mine in North Carolina.—William Trelease, on the fertilisation of *Calamintha nepeta* (woodcuts).—S. V. Clevenger, comparative neurology.—E. L. Greene, botanising on the Colorado desert.—W. J. Beal, on a method of distinguishing species of poplars and walnuts by their young leafless branches (woodcuts).—James L. Lippincott, an address to the fossil bones in a private museum.—The Editor's table: Recent Literature.—General Notes [this portion of the journal has been very considerably enlarged with this number. The Botanical, Zoological, Entomological, Anthropological, Geological, Geographical, and Microscopical Sections are each under the charge of a special editor as formerly].—Scientific News.—Proceedings of Scientific Societies.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 27.—"The Refraction Equivalents of Carbon, Hydrogen, Oxygen, and Nitrogen in Organic Compounds." By J. H. Gladstone, Ph.D., F.R.S.

Since the communication which I had the honour to read before this Society in 1869, "On the Refraction Equivalents of the Elements," very little has been done on the subject.

Of late however its importance in regard to theories of chemical structure has been recognised by Dr. Thorpe and other chemists in this country, and attention has been recalled to it in Germany by the papers of Brühl, who, following closely in the footsteps of Landolt, has endeavoured to explain the results in the language of modern organic chemistry.

At this juncture it may be of service to put on record my present views in regard to the refraction equivalents of the four principal constituents of organic bodies—carbon, hydrogen, oxygen, and nitrogen.

Carbon.—Carbon in its compounds has at least three equivalents of refraction, 5·0, 6·0, or 6·1, and about 8·8.

Whether its refraction should be one or other of these appears to depend on the way in which the atoms are combined.

When a single carbon atom has each of its four units of atomicity satisfied by some other element, it has a value not exceeding 5·0.

When a carbon atom has one of its units of atomicity satisfied by another carbon atom and the remainder by some other element, it has the value of 5·0. This is also the case if two of its units of atomicity are satisfied by carbon atoms.

When a carbon atom has three of its units of atomicity satisfied by other carbon atoms, its value is 6·0. The most striking instance is that of benzol, C_6H_6 (refraction equivalent 43·7).

There are other organic compounds in which only some of the atoms of carbon have the higher value. It has been especially the work of Brühl to point this out, and to show that where they occur (as in amylene or the allyl compounds) the carbon atom is in a condition similar to those in the phenyl nucleus, that condition in fact which is generally represented in our graphic formulæ by two carbon atoms linked by double bonds. The value assigned by Brühl in such cases is however 6·1. This somewhat higher figure is deduced from the aggregate value of the six carbon atoms in the nucleus of the aromatic series, which (except in benzol and its simpler substitution products) would appear to be nearer 37 than 36. The fact however is susceptible of another interpretation. The replacement of hydrogen by some nomad radicle is an important change; and if that radicle be CH_3 it is evident that according to present views the carbon atom must have all four of its units of atomicity satisfied with carbon, and by analogy we should expect it to have its refraction increased.

When a carbon atom has all four of its units of atomicity satisfied by other carbon atoms, each of which has the higher value of 6·0 or 6·1, its equivalent of refraction is greatly raised. There are compounds in which the atoms of carbon actually out-number the atoms of hydrogen or its substitute, such as naphthalene, $C_{10}H_8$ (ref. eq. 75·1), naphthol, $C_{10}H_8O$ (79·5), phenanthrene, $C_{14}H_{10}$ (108·3), and pyrene, $C_{16}H_{10}$ (126·1). That the refraction is greatly raised is evident from the fact that, if we were to reckon all the carbon atoms at 6·1, the refraction equivalent of the body would not be fully accounted for. It is evident that in pyrene only ten of the atoms of carbon can be in the same condition as they are in benzol or styrol, the other six must have all their units of atomicity satisfied by carbon alone. Provisionally I venture to assign 8·8 as the refraction equivalent of this highest carbon.

There are several other bodies, such as anthracene, anethol, furfurol, and hydride of cinnamyl, which from their abnormally high refraction appear to contain carbon in this last condition.

Hydrogen.—The general evidence with regard to hydrogen in organic compounds tends to show that it has only one refraction equivalent, that originally assigned to it by Landolt, 1·3.

Oxygen.—Brühl has been the first to point out that oxygen in organic compounds has two values, and he comes to the conclusion that it has the value 3·4 where the oxygen is attached to a carbon atom by a double linking, but 2·8 in hydroxyl and where the oxygen is united to two other atoms. This is deduced from experimental data. But there are other results which present difficulties, such as the various alcohols.

Nitrogen.—Nitrogen has two values, 4·1 and 5·1, or thereabouts.

The lower value, 4·1, is that originally deduced from cyanogen and metallic cyanides, and it seems to be generally confirmed by the observations on organic cyanides and nitriles. The higher value, 5·1, is deduced from observations on organic bases and amides.

I hope shortly to submit to the public the whole of the data for these conclusions.

February 3.—"On the Influence of Temperature on the Musical Pitch of Harmonium Reeds." By Alex. J. Ellis, F.R.S.

The writer gave a tabular account of the experiments on the harmonium reeds of Appunn's treble tonometer at South Kensington Museum, at temperatures differing by from 20° to 26° F., which rendered it probable that the pitch of such reeds was affected by temperature to twice the extent of tuning-forks and in the same direction, that is, that they flattened by heat and sharpened by cold about 1 in 10,000 vibrations in a second for each degree Fahrenheit.

"On an Improved Bimodular Method of computing Natural and Tabular Logarithms and Anti-Logarithms to Twelve or Sixteen Places, with very brief Tables." By Alex. J. Ellis, F.R.S.

A bimodular method is one founded on the familiar proposition, that if the bimodulus (that is, twice the modulus of any system of logarithms) be multiplied by the difference and divided by the sum of two numbers, the result would be approximatively the difference of their logarithms. The improvement consisted in a simple preparation of a given number to make it lie between two numbers in a given table of interpolation, consisting of 100 entries, and in then determining how many places might be trusted without correction, and in correcting the result by a short table so as to give twelve places at sight and sixteen places by means of ordinary table of seven figure logarithms. The antilogarithms were found by first depriving a logarithm of its correction, and then dividing the result added to the bimodulus by the result subtracted from the bimodulus—an entirely new rule. Complete tables and worked-out examples fully explained were added.

"On the Potential Radix as a Means of Calculating Logarithms to any Required Number of Decimal Places, with a Summary of all Preceding Methods Chronologically Arranged," by Alexander J. Ellis, F.R.S.

A positive numerical radix consists of the numbers r, $1 + \cdot 0_m r$, and their logarithms, where r varies from 1 to 9; 0_m means a series of m successive zeros, and m varies from 1 to any required number. The term "radix" is due to Robert Flower (1771) and is preserved *in memoriam.* It was shown that such a table would enable any logarithm to be calculated by the improved bimodular method and other methods. A negative numerical radix consists of the numbers $1 - \cdot 0_m r$, and their negative logarithms, and it was shown that such a table would serve the same purpose somewhat more easily. Hence the whole process is reduced to the construction of such radixes. A chronological summary was then given of all preceding methods, showing that most of them depended on having such radixes. The construction of a numerical radix is however a very long and troublesome process by the methods ordinarily used. For this purpose the potential radix for natural logarithms was first constructed, consisting of 10^r, 2^r, $(1 \cdot 1)^r$, and $(1 \cdot 0_m 1)^r$, negative $(1 - \cdot 0_m 1)^r$, from $r = 1$ to $r = 10$ (the latter terms being calculated by simple addition), and their natural logarithms, first to any number of places from the very simple series for nat. log. $(1 \pm \cdot 0_m r)$, and secondly, by simple addition. This gives a radix from which natural logarithms of all numbers can be calculated to any number of places by the improved bimodular method. But the main use of the potential radix is to calculate the nat. logs. of the numbers of the numerical radix. The radix for tabular logarithms is then found by multiplying by the modulus, already calculated from the potential radius. All this was fully explained by tables and examples.

Mathematical Society, February 10.—Mr. S. Roberts, F.R.S., president, in the chair.—Mr. W. Woodruff Benson, University of Michigan, was elected a member, and Prof. Rowe and Mr. J. Parker Smith were admitted into the Society.—The following communications were made:—On some integrals expressible in terms of the first complete elliptic integral and of gamma functions, by Mr. J. W. L. Glaisher, F.R.S.—Some theorems of kinematics on a sphere, by Mr. E. B. Elliott, M.A.—Supplement on binomial biordinates, by Sir J. Cockle, F.R.S.—An application of conjugate functions (to the case of membranes), by Mr. E. J. Routh, F.R.S.—Note on Abel's theorem, by Mr. T. Craig.

Linnean Society, February 3.—Robt. McLachlan, F.R.S., in the chair.—Lieut.-Col. A. A. Davidson was elected a Fellow.—Examples of Prof. C. Semper's method of preserving the soft tissues of animals as teaching-specimens were exhibited on behalf of Herr L. Würth of Würzburg.—Mr. G. Murray exhibited and made remarks on a Japanese book containing wood sections.—Mr. C. Craig-Christie exhibited, and a note was read on, the presence of what appeared to be deciduous stipules in *Ilex aquifolium*, thus contrary to the usually-accepted assertion that the order Ilicineæ is exstipulate.—The following paper by Mr. G. Bentham was read: "Notes on Cyperaceæ; with special reference to Lestiboudois' Essay on Beauvois' Genera." The essay in question was founded on Palisot and Beauvois' MS., which was originally intended to follow his "Agrostographia," and has been almost entirely lost sight of, and random guesses have been made at the species intended by the short characters given in Roemer and Schultze's "Systema."—Nees von Esenbeck, in the 7th, 8th, and 10th vols. of the "Linnæa," and Supplement 123, or Kunth in vol. ii. of his excellent "Enumeratio," appear to have correctly identified many of these. Eighteen so-called genera are now referred to various established genera. Steudel's Synopsis is marred by the author's hazy ideas of species. Boekeler has a thorough knowledge of species, but his diagnoses are often excessively long. Mr. Bentham proposes few changes in the order of genera as set forth by Kunth, and he considers that Boekeler's primary division of the order as to whether the fertile flower is hermaphrodite or female only, bears the test of detailed examination.—Hermaphrodite flowers:—(1) Scirpeæ, (2) Hypolyteæ, (3) Rhyncasporeæ. Unisexual flowers:—(1) Cryptangeæ, (2) Scheriæ, (3) Cariceæ.—A paper was read by Mr. A. D. Michael, observations on the life history of Gamasinæ. In this the author endeavours to decide some of the disputed and knotty points in reference to these humble parasites; M.

Megnin of Versailles and Dr. Kramer of Schleusingen, both good authorities on the subject, being at variance thereon. Mr. Michael, believing that detached observations on captured specimens may have produced unreliable results, has himself bred Gamasids, closely followed their changes and growth, and watched their manners, and thus has arrived at what he on good grounds assumes to be important results respecting their life-history. He states that the remarkable power of darting each mandible separately with speed and accuracy of aim far in advance of the body, the powerful retractile muscles attached to these mandibles, the organisation of the remainder of the mouth, the extreme swiftness of the creatures, the use of the front legs as tactile organs only, and not for the purpose of locomotion, and the ample supply of tactile hairs in front only, seem to fit the animals for a predatory life, and point to habits similar to those of *Cheyletus* and *Trombidium*, rather than to those of the true vegetable-feeders, such as the Orbatidæ and Tetramachi. He further concludes (1) that Megnin is correct in saying *Gamasus coleoptratorum* and other allied creatures, with the conspicuously-divided dorsal plates, are not species at all, but are immature stages of other species; (2) that the division of the dorsal plate is, in most cases at all events, a question of degree, and does not form a sound basis for classification, as applied by Koch, Kramer, and others; (3) that the dorsal plates do not grow gradually, but alter in size, shape, or development at the ecdysis; (4) that Megnin is right in saying that the characteristic of the so-called *G. marginatus* is simply a provision possessed by the females of a large number of species; (5) that the extent of the white margin depends upon the extent to which the abdomen is distended by eggs; (6) that Megnin is in error in saying that *Coleoptratorum* is the nymph of *Crassipes*. The nymph of *Crassipes* does not show any divided dorsal plates which can be seen on the living creature; (7) that in the species bred there has not been observed any inert stage before the transformations or ecdysis; (8) that in the same species copulation takes place with the adult female, and not with the immature one, as Megnin contends, and that it is by the vulva, not the anus.—Two papers were read on the coffee-leaf disease (see Science Notes, p. 354).

Institution of Civil Engineers, February 8.—Mr. Abernethy, F.R.S.E., president, in the chair.—A paper on the temporary works and plant at the Portsmouth Dockyard Extension, by Mr. C. H. Meyer, Assoc. M. Inst. C.E., was read.

PARIS

Academy of Sciences, February 7.—M. Wurtz in the chair.—The following papers were read:—On photographs of nebulæ, by M. Janssen. It is comparatively easy to get a photographic image of the brightest parts of nebulæ, but very difficult to get complete images which may serve for future comparison. The optical and photographic conditions should be exactly defined. M. Janssen suggests taking for criteria images of stars, with plates a little out of focus, so as to give an opaque circle. Five or six of these stellar circles accompanying the photograph of a nebula would indicate what the conditions had been.—On the thermic formation of pyrogenic carburets, by M. Berthelot.—Some remarks on the characters of chloro-organic gases and vapours, by M. Berthelot. The formation of a white precipitate in neutral or slightly acid nitrate of silver, traversed by a gaseous current, is not a sufficient character of chlorine or hydrochloric acid.—Examination of materials from some vitrified forts of France; conclusions, by M. Daubrée. The methods of producing these forts seem to have been various. To soften a rock like granite (sometimes used), to fuse its mica, and even, at times, its felspar, in thicknesses of several metres, implies large use of fuel and prolonged skilful effort. The fire was probably applied *within* the walls, and a current of forced air may have been used, besides draught. The makers unconsciously produced some minerals that have only of late been reproduced in the laboratory.—On the Great Canal de l'Est and the machines set up to ensure its alimentation, by M. Lalanne. This canal (made in consequence of the change of frontier in 1871) runs from near Givet, on the Meuse, by Mezières, Sedan, Commercy, Toul, &c., to Port-sur-Saône (it includes, in a total length of 468 km., 20 km. of the canal from the Marne to the Rhine). There are two large pumps in the Moselle valley, worked by the water of that river, also steam-pumps at Vacon. Two large reservoirs are projected, one near Paroy, the other at Aouze.—Study of actions of the sun and the moon in some terrestrial phenomena, by M. Bouquet de la Grye.—Observations of Perseids at Toulouse Observatory in 1880, by M. Baillaud. 1172 falling stars were counted on August 9, 10, and 11; the maximum was on the 10th, between 14h. and 15h. The trajectories were generally very short, and their extremities pretty far from the radiant point. The meteors were divisible into two groups.—On modes of transformation which preserve lines of curvature, by M. Darboux.—On simultaneous linear differential equations, with rational coefficients, whose solution depends on the quadrature of a given irrational algebraic product, by M. Dillner.—On a property of the product of k integrals of k linear differential equations, with rational coefficients, the solution of which depends on the quadrature, respectively, of k rational functions of the independent variable, and of a given algebraic irrationality, by the same.—The problem of remainders in two Chinese works, by M. Matthiessen.—On a peculiar phenomenon of resonance, by M. Gripon. A tuning-fork, giving a simple sound, will set in resonance masses of air which produce a sound comprised in the harmonic series of the fork's sound. The form of the mass of air is unimportant. One grave fork set in vibration forks which gave harmonic sounds, but not others, the two forks being connected by very fine copper wire (stretched).—On elliptic double refraction, and the three systems of fringes, by M. Croullebois.—On a new apparatus for showing the dissociation of ammoniacal salts, by M. Tommasi. In a glass tube is hung with platinum wire a strip of blue litmus paper that has imbibed a concentrated solution of chlorhydrate of ammonia. On putting this dissocioscope in boiling water, the sal-ammoniac is dissociated and the paper turns red; if then put in cold water the dissociated ammonia combines again with the acid, and the paper turns violet again.—On derivatives of acroleine, by MM. Grimaux and Adam.—Action of hydrochloric acid on aldehyde, by M. Hauriot.—Inoculation of the dog for glanders, by M. Galtier. The dog may contract the disease (through inoculation) and recover many times; but its receptivity (comparatively small at first) gradually diminishes, and, there is reason to believe, may be quite effaced. The power of the virus is attenuated by successive cultivations in the dog; this appears in an ass, *e.g.* inoculated with the later virus of a dog inoculated several times.—Physiology of dyspepsia, by M. Sée. In grave dyspepsia the stomach pump may advantageously be used to clear the stomach of liquids unfavourable to digestion.—On the histology of the pedicellaria and muscles of the sea urchin (*Echinus sphæra*, Forbes), by MM. Geddes and Beddard.—Researches on the development of sterile sporangia, in *Isoetes lacustris*, by M. Mer.

VIENNA

Imperial Academy of Sciences, February 10.—V. Burg in the chair.—C. Heller, on the distribution of the fauna of the high mountains of Tyrol.—R. Maly and F. Hinseregger, studies on caffeine and theobromine (second paper).—V. Hochstetter, on the Kreutzberg Cave, near Laas, in Carniola, and *Ursus spelæus*.—R. Puluj (1) on radiant electrode-matter; (2) remarks relating to the priority claimed by Dr. Eugen Goldstein.

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